Mighty Mini Motor

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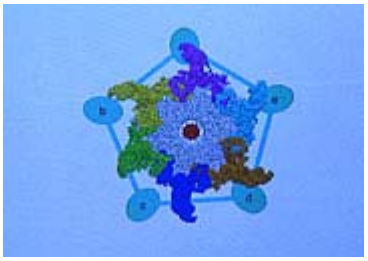
Nanotechnologists try to create new materials or incredibly tiny machines by manipulating atoms and molecules. One of nanotechnology's biggest dreams is biomedical devices that could travel anywhere inside your body and fix parts that need repair.

Today, some scientists have already made a start on this dream. They're making incredibly tiny motors that could drive the world's smallest machines, and help keep us well.

Video



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Motor Made of Molecules

RNA, or ribonucleic acid, is a cousin of more familiar DNA. Although it has not been studied as thoroughly as its relative, RNA may be the most important molecule for living systems. Along with DNA and protein, RNA is one of the key components of a living cell. There are many kinds of RNA in the human body. RNA molecules can act as messengers, transporters, and translators of genetic information coded by DNA, as well as switches that turn genes on or off. But researchers are still trying to figure out what most varieties of RNA do and how they work.

At Purdue University's School of Veterinary Medicine, molecular biologist Peixuan Guo thinks that RNA has enormous potential for nanotechnology because it is an extremely flexible molecule. "RNA is much easier to make than protein," Guo explains, "and compared to DNA, it comes in many more sizes and shapes. With DNA, we are limited to its double helix structure."

Guo and his research team have discovered that RNA binds adenosine triphosphate, or ATP, the chemical fuel that proteins use in the body to allow muscles to move and nerves to function. "ATP works the way gasoline does in a car," says Guo. "You could not walk or talk or think without the chemical fuel of ATP."

The Purdue team's discovery meant that RNA could be capable of doing physical work, providing the motor for a nanoscale machine. "The world's smallest machines will need molecular motors," says Guo. "If we could use ATP, an organic chemical, as fuel, we won't have to develop any special sources of power." Guo's team set out to find a way to use ATP to move RNA around.

The result, says Guo, "looks like a hex nut and bolt." The researchers used several strands of RNA to make a six-sided nut, or engine. Inside the nut, they placed a strand of DNA as the bolt, or engine axle. When they fuel the tiny motor with a supply of ATP, the six sides of the nut kick against the bolt, one after the other, just as pistons fire in succession inside a combustion engine.

According to Guo, the motor, which is 1/3000 the width of a human hair, can generate more force than any other molecular motor to date. Guo's motor functions the way a muscle does, flexing and relaxing. When RNA strands in the motor bind with ATP, the motor switches on, or flexes. When researchers prevent the RNA from binding ATP, the motor turns off, or relaxes.

Guo thinks that his motor could become an important part of gene therapy, driving into damaged cells to repair them with healthy genes or other biomaterials. His team has already successfully used the motor to destroy hepatitis virus inside a cell.

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